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(54) **Electrode assembly for high-frequency heating and coagulating apparatus.**

(57) An electrode assembly suitable for use in an apparatus for heating and coagulating a living tissue by a high-frequency current, comprises a planar electrode (3) having a terminal (5), which is connected to a high-frequency power supply, and a working face (3) in the form of a flat or convex surface, and a hollow cooling chamber (4) for cooling the working face from the back side thereof, said planar electrode and hollow cooling chamber being formed integrally with each other.

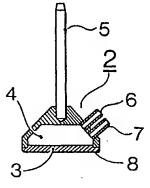

Fig.1

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The present invention relates to an electrode assembly suitable for use in an apparatus for heating and coagulating a living tissue by e high-frequency current, and more specifically to an electrode assembly equipped with e cooling device, by which a high-frequency current is caused to flow from above the skin through a living tissue in order to selectively heat and coagulate the subcutaneous tissue. The high-frequency heating and coagulating apparatus equipped with this electrode assembly is usable for remedying superficial vascular diseases such as hemangioma, end tumors in a shallow site under the skin or for removing fat by atrophy of the subcutaneous fat without receiving any thermel injury to the human epidermis.

It has been used in surgical operations or the like for a long time to cauterize or heet and coagulate a living tissue by utilizing a high-frequency current. For example, it is described in Japenese Petent Application Laid-Open No. 211060/1987 to burn off the affected pert in e living cavity. It is also described in Jepenese Patent Application Laid-Open Nos. 185847/1982 and 24933/1988 to heat end coegulete e living tissue with e view toword erresting bleeding of the tissue.

Besides, it hes recently been proposed by the present inventor that e needle-like working electrode is thrust into the skin to cause e high-frequency current to pass through the skin so as to heat and coagulate en intended subcutaneous tissue alone without leeving eny scar on the epidermis (see Japanese Utility Model Application Laid-Open No. 114147/1984 end Jepenese Petent Applicetion Laid-Open No. 277948/1987). Namely, according to the device of Jepenese Utility Model Application Laid-Open No. 114147/1984, the needle-like electrode is thrust into the skin near the affected part of the human body to ceuse the high-frequency current to pess through the skin, thereby heating and coagulating hypertrophied capillary vessels, by which hemangioma is caused, to extinguish them. The operation is conducted without leaving eny thermel injury on the epidermis by applying an insulating coating to the surfece of the needle-like electrode except its tip. Also, according to the invention of Japanese Patent Application Laid-Open No. 277948/1987, artificial heir is implanted in the skin of the human body and et the same time, a high-frequency current is caused to flow through a hair-implanting needle to heat end coagulate the subcutaneous tissue near the root part of the artificial hair implanted, thereby increasing the fixing rate of the artificial hair.

The invention of Japenese Patent Application Laid-Open No. 211060/1987 is characterized in that the electrode is brought into direct contact with the affected part to cause e heevy high-frequency current to flow through the affected part, thereby burning off the effected part. Also, in the invention of Japanese Patent Application Laid-Open No. 24933/1988, the electrode is brought into direct contact with the affected part to cause a high-frequency current to pass through the effected part, thereby heating and coagulating the affected part to effect its hemostasis or the like. In order to bring the electrode into direct contact with the effected part as described above, there is however a disadvantage that the skin must be incised to expose the affected part before using this process.

The invention of Japanese Patent Application Laid-Open No. 185847/1982 features that a high-frequency current is caused to flow through the affected part via en electrically conductive fluid, thereby heating and coagulating the affected part. In this process, no electrode is brought into direct contact with the effected part, but the fluid is brought into direct contact with the affected part. Therefore, the process involves a disadvantage that it can not be used unless a tube for feeding the fluid is inserted deep into the body cavity in order to bring the fluid into direct contact with the affected part.

Beside, according to both device of Jepenese Utility Model Application Leid-Open No. 114147/1974 and invention of Japanese Petent Application Leid-Open No. 277948/1987, an electrically insulating coating film is applied to the surface of the working electrode leaving its tip elone so as not to cause the high-frequency current to flow through the surfece of the skin, thereby heating end coagulating the intended subcutaneous tissue elone without leaving any scar on the surfece of the skin. However, this process is accompenied by disadventages thet the needle-like working electrode must be thrust into the skin end moreover, its remedy region is extremely limited because the working electrode is in the form of a needle, so that extremely poor efficiency is only obtained when using for purposes other than the hair implantation.

According to the present invention, a subcutaneous tissue is coagulated by indirectly heating the tissue from above the skin without inserting or thrusting any electrode into the body of a patient.

Generally speaking, when coagulation by high-frequency heating is caused to undergo, a high-frequency current having a frequency of 0.5-10 MHz, preferably of 2.5 MHz or less is used. The electric current is caused to flow from a working electrode to e distributed electrode as a counter electrode with a humen body interposed therebetween.

In general, when an electrode is pleced on the skin to cause the high-frequency current to flow, the tissue under the skin can be coagulated by Joule heet generated by the high-frequency current. However, the skin itself is also necessarily heated, thereby causing so-called dermal burn.

It is therefore a first object of this invention to provide en electrode assembly for a high-frequency heet-

ing and coagulating apperetus, which permits selective heating and coeguletion of a tissue elone in a deep site under the skin without doing any injury to the epidermis.

It is e second object of this invention to provide en electrode assembly for e high-frequency heeting end coagulating apparatus, which is capable of treating en affected part positioned under the skin and extending to a relatively wide region at once without doing eny injury to the epidermis.

The electrode assembly for the high-frequency heating end coagulating epperatus according to the present invention comprises a planar electrode having a terminel, which is connected to a high-frequency-current power supply, end a working face in the form of a flet or convex surface, and e hollow cooling chamber for cooling the working face from the back side thereof, seid planar electrode end hollow cooling chamber being formed integrally with each other.

A high-frequency current supplied to the planar electrode having the working face in the form of the flet or convex surface flows through the skin from the working face into the body to heat the skin end the subcutaneous tissue. At that time, when e coolant is circuleted through the cooling chamber provided on the back side of the planer electrode to cool the plener electrode from the inside, heet near the surfece of the skin is absorbed in the electrode, so thet the temperature of the skin surface is not raised. It is therefore possible to heat and coegulate the subcutaneous tissue alone in the deep site without receiving eny thermal injury to both epidermis and subcutaneous tissues in the shallow site.

The forms of the planar electrode and working face ere determined on the besis of the intended epplication end difficulty in fabrication of the electrode essembly.

It is however common to use e circuler electrode and a working face shaped in a circuler form correspondingly.

When the affected part is vertically elongate, a working face in the form of en ovel or rectangle is however used. On the other hand, when the fat under eyes is removed, e semicircle or crescent, or if circumstances require, triengle, trapezoid or the like may be used. In eny event, the shape and size according to those of the effected part will be required of the working face.

However, the peripheral pert of the planar electrode is cooled to e lesser extent compared with the central pert thereof. Therefore, when a planar electrode in e circular form by way of exemple is used, there may be instances where the surface of the skin receives e slight ring-like burn.

Accordingly, in this invention, en ennular cooling surface hes been provided so es to surround the periphery of the working face of the planar electrode to cool the peripheral part of the planar electrode higher, whereby the occurrence of the ring-like burn is prevented.

As e specific structure for providing such en ennuler cooling surfece thet the periphery of the working fece of the plener electrode is surrounded, its purpose is ettained by integrally forming the plenar electrode end the hollow cooling chamber with en electrically conductive material and annularly coating the peripheral part of the planar electrode with an electrical insulating material having good thermal conductivity. Namely, the peripheral part of the planar electrode, which hes been coated with the electrical insulating material, becomes impossible to give off any high-frequency current due to a coating film of the electrical insuleting materiel. On the other hand, since the plener electrode is inherently mede of e , metallic material heving good thermel conductivity, end the ennuler coating film is also formed of the electricel insulating material having good thermal conductivity, this annular portion functions as a cooling surface. Accordingly, the region inside the ennuler cooling surface becomes a working face of the planar electrode.

As examples of the electrically conductive material making up the electrode, may be mentioned stainless steel, brass, phosphor bronze, silver, etc. However, bress is preferred in thet it is relatively high in electricel conductivity, good in processability end cheep.

Examples of the electrical insulating materiel heving good thermal conductivity include plestics, glass, ceramics, insuleting coatings, insulating varnishes, etc. When a ceramic is used in particuler, it is preferebly non-porous. Namely, a ceremic meterial having en extremely fine particle size, for example, e sintered body or film of micronized elumine, or the like is preferred. As enother embodiment for providing the ennuler cooling surfece, its purpose is also ettained by en electrode essembly in which the hollow cooling chember is made up of en electrical insulating meterial having good thermal conductivity so es to have a bottom surface greater than the plener electrode, and the planar electrode is fitted in the bottom surface et the substantiel center thereof, whereby e remaining portion of the bottom surfece, which is outside the periphery of the electrode, is teken es en ennuler cooling surface.

In the cese of this embodiment, e portion of the bottom surfece of the cooling chember, which corresponds to the plener electrode, mey be recessed to fit the plenar electrode in the recess. However, it is preferred from the viewpoint of increased cooling efficiency thet only the portion corresponding to the planar electrode is hollowed out in the bottom surfece of the cooling chamber to fit the plenar electrode therein, whereby the plener electrode is caused to serve for e bottom surfece of the cooling chember, too.

As a further embodiment, the outer peripheral

surface of a curved tube made of an electrically conductive material is coated with an electrical insulating material. The insulating film on the convex surface of the tube is then removed by grinding, thereby forming an ovel working face of the planar electrode. The tube itself serves es e cooling chamber.

A coolent is introduced into the cooling chember to cool the plener electrode from the back side thereof. Therefore, the cooling chamber is provided with an inlet port end en outlet port for the coolant.

Examples of the coolant may include liquids end gases. Water, saline, an aqueous solution of ethylene glycol or the like may be used as a liquid coolant.

Since a temperature of about 0 to -10°C is sufficient for the temperature of the coolant, water or seline may be cooled or supercooled with ice and then circulated. For that purpose, it is only necessary to construct e cooling system so as to plece ice in a weter tank and circulate water through the water tank by a circulating pump.

In the case of the gas, liquid nitrogen, liquid CO_2, Freon gas, high-pressure air or the like may be used. When each of these gases is used, its cooling system is constructed so as to provide a nozzle in the electrode assembly, jet the liquid gas or high-pressure gas out of the nozzle and adiabatically expand the gas to give heat for cooling. For that purpose, it is necessary to provide a high-pressure pipe communicating with a container for the liquid or high-pressure gas, and a nozzle adapted to jet the gas out in the cooling chamber and fitted on the tip of the pipe.

By the way, with respect to the outlet port, it is only necessary to provide several holes for discharging the gas in the outside air in optional positions of the cooling chamber except for the case where the gas requires to be recoverad in particular.

When the electrode assembly according to the present invention and a distributed electrode are used as a working electrode for a high-frequency heating and coagulating apparatus and as a counter electrode thereof, respectively, a humen body is placed between the working electrode end the distributed electrode, and a high-frequency current of, for example, 1 MHz and 50 W in the case where the diemeter of the working electrode is 14 mm is caused to flow, the skin abutting on the working electrode is heeted. When et thet time, a coolent of 0°C is forcedly circuleted through the cooling chamber, the skin abutting on the working electrode is cooled, so that only the subcutaneous tissue in the deep site under the working electrode is heated. When the above-described high-frequency current is caused to flow for about 3 seconds, tissues down to ebout 2 mm from the epidermis are not in eny wey changed, but deeper subcutaneous tissues down to about 6 mm are heated to about 90°C, whereby proteins in the tissues within thet range are coagulated.

When et thet time, the plenar electrode heving e working face in the form of a flat or convex surface is used, it is possible to heat end coagulate the effected part under the skin extending to a considerably wide region from ebove the skin, thereby attaining the intended remedy, or to coagulete end atrophy the subcutaneous adipose tissue, thereby substantially decreasing the subcutaneous fat.

However, when e reletively heavy high-frequency current is caused to flow, there mey be instances where the surface of the skin receives e slight ring-like burn elong the periphery of the plenar electrode. This is attributed to the insufficient cooling of the planar electrode at its peripheral part.

According to other embodiments of this invention, in order to overcome the above-described defect, the cooling chamber is constructed in such a manner that the annular cooling surface provided so es to surround the periphery of the working face of the planar electrode is also cooled from its back side, whereby the peripheral part of the planar electrode is cooled higher and hence, the occurrence of the ring-like burn is prevented.

The examples of the present invention will hereinafter be described with reference to the accompanying drawings.

The drawings illustrate electrode assemblies for a high-frequency heating and coagulating apparatus according to embodiments of the prasent invention. FIG. 1 ls a cross-sectional view of an electrode assembly according to an embodiment thereof; FIG. 2 is a cross-sectionel view illustrating an electrode assembly according to another embodiment; FIG. 3 is e bottom plan view of the electrode assembly of FIG. 2; FIG. 4 is a cross-sectional view illustrating an electrode assembly according to a further embodiment; FIG.5 is a bottom plan view of the electrode assembly of FIG. 4; FIG. 6 is a cross-sectional view illustrating an electrode assembly according to a stillfurther embodiment; FIG. 7 is e bottom plan view of the electrode assembly of FIG. 6; FIG. 8 is a cross-sectional view illustrating an electrode assembly according to yet a still further embodiment; FIG. 9 is e bottom plan view of the electrode assembly of FIG. 8; FIG. 10 is en explenatory view illustrating a high-frequency heeting and coagulating epperatus equipped with en electrode essembly eccording to this invention es used; FIGS. 11 and 12 are explenetory views illustrating the heated end coegulated conditions of the subcutaneous tissue es a result thet the high-frequency heating and coagulating apparatus separately equipped with electrode essemblies according to this invention has been used. The numerals used in the drawings ara es follows:-

1: electrode essembly;
2, 12, 22, 32: electrode bodies;
3, 13, 23, 33: planer electrodes;
4, 14, 24, 34: cooling chembers;
5: terminel; 6, 26, 36: inlet ports for coolent;

7, 27, 37: outlet port for coolant;
8: outar peripharal part;
9, 19, 29: annular cooling surfaces;
10, 10': working faces; 30: nozzle;
41: high-fraquancy genarator;
42: coolant tank; 46: distributed elactroda;
50: surface of skin; 52, 52': coagulated regions

Example 1:

In this exampie, an electrode assembly making usa of a liquid coolant as a coolant and, in particular, corresponding to that of claim 1 will be described.

As illustrated in FIG. 1, an electrode body 2 is formed of a metal having good electrical conductivity, for example, brass, and is substantially in the form of a hollow cona as a whole. Its bottom surfaca servas as a planar electroda 3 and its upper conical part forms a cooling chamber 4. In the upper part of tha conical cooling chamber 4, thare is providad a rod-lika tarminal 5 for connecting to a high-frequency genarator (not illustrated), and an inlet port 6 and an outlet port 7 for the liquid coolant are separately providad in its side wall.

In this drawing, the planar electrode 3 of the bottom surface is illustrated in the form of a flat surface. It is however preferred that the electrode is shaped in a slightly convex form because an outer peripheral part 8 of the planar electrode 3 is cooled to a lessar extent and hence, thara may ba instances whare tha surface of the skin receives a ring-lika burn.

Exampla 2:

In this example, an electrode assambly corresponding to that of one of claims 3 and 4 in particular will be described. The outer periphery part of a planar electrode is coated with an alectrical insulating material in order to positively prevent the occurrence of the ring-like burn in Example 1. As illustrated in FIGS. 2 and 3, an electroda body 2 is, as with that in Exampla 1, formed of a metal having good elactrical conductivity, and is in the form of e hollow cone. Its bottom sarvas as a planar electrode 3 and its upper part forms a cooling chamber 4. An annular coating film 11 composed of an alectrical insulating matarial having good thermal conductivity is applied from the outer periphery of the planar electrode 3 to the foot of the cooling chamber 4.

By this annular coating film 11, a working faca 10 of tha planar alectroda 3 is defined to a region inside the annular coating film 11. On the other hand, the peripheral part of the planar alectroda 3, which has been coatad with the annular coating film 11, functions as an annular cooling surface 9.

In this exampla, a sinterad film obtained by baking alumina powdar of 500 maah or finar and having a thickness of 150 µm is usad as an alactrical insulating material having good thermal conductivity.

Besides, salina cooled with ice is circulated for use as a coolant.

Exampla 3:

In this axample, an electrode assembly corresponding to that of one of claims 3 and 6 in particular will be described.

As illustrated in FIGS. 4 and 5, an electroda body 12 comprises a planar electrode 13 made of an electrically conductive material such as a metal and a conductor 18 extending upright from an upper center of the planar electrode 13. The tip of the conductor 18 serves as a terminal 5 for connecting to a high-frequency generator (not illustrated). A cooling chambar 14 is providad so as to surround tha planar alectrode 13 and a lower end of the conductor 18.

Tha cooling chambar 14 is formad of an alactrical insulating matarial having good thermal conductivity, for example, a plastic such as a rigid polyvinyl chloride, or a ceramic molding. An inlet port 6 and an outlet port 7 for a liquid coolant ara separately provided in a sida wall of the cooling chamber 14.

Since tha planar electrode 13 is surroundad with the cooling chamber 14, which is a size larger than the planar electrode 3, as described above, a bottom portion of tha cooling chamber 14, which is in an annuiar form, sarves as a cooling surface 19.

Example 4:

In this axampla, an electrode assembly corrasponding to that of one of claims 3 and 5 in particular will ba dascribed.

As illustrated in FIGS 6 and 7, an electrode body 22 is constructed by a curved tube 20 formed of an electrically conductive material such as a metal. Both ends of the tube 20 are sealed, and a conductor 28 is provided upright on an upper center thereof. The whola outar surface of the tube 20 is applied with a coating film composed of an alactrical insulating material. However, a convex surface of the tuba 20 is subjacted to grinding to expose the metal surfaca, thereby forming an oval working faca 10' of a planar alactrode 23.

An inlet port 26 and an outlet port 27 are respectively attached on both ends of the tube, whereby the tube forms a cooling chamber 24 as a whole.

An annular region situated on the bottom surface of the cooling chamber 24 and surrounding the planar alectroda 23 functions as a cooling surface 29.

By tha way, tha tip of the conductor 28 forms a terminal 25 for connacting to a high-frequency genarator (not illustrated).

Example 5:

In this exemple, the case where e gaseous coolant is used es e coolant will be described.

As shown In FIGS. 8 and 9, a bottom of a hollow electrode body 32 in the form of e flattened cylinder, which is formed of e metal having good electrical conductivity, is used es e planar electrode 33, end the portion above the bottom is utilized es e cooling chember 34.

To the upper center of the cooling chamber 34, is connected upright e high-pressure pipe 38 for introducing e coolent. An inlet port 36 for e geseous coolant Is fitted to a side well of the high-pressure pipe 38. An upper end of the high-pressure pipe 38 is sealed by a rod-like terminal 35 for connecting to a high-frequency generator (not illustrated). An internal surface of the high-pressure pipe 38 in a joint between the high-pressure pipe 38 and the cooling chamber 34 Is constricted, thereby forming a nozzle 30. A coolant, such as e liquid ges, introduced through the inlet port 36 for the gaseous coolant performs a cooling action in the following manner. It is jetted out of the nozzle 30 of the high-pressure pipe 38 to edlebatically expend and hence generate heat for cooling, thereby taking up heet from the circumference of the cooling chember 34.

The coolent vaporized is discherged in the outside air through discherge ports 37 bored in the cooling chember 34 along its periphery.

In the drawing with respect to this example, the planar electrode 33 of the bottom surfece uses the whole surface as a working face. However, it is more preferable to provide en annular cooling surface formed of en insulating film on the outer peripheral part of the planar electrode 33 es described In Example 2.

The method of application of the electrode assembly of this invention will hereinafter be described.

As illustreted in FIGS. 10, 11 end 12, the terminal 5 of the electrode essembly 1 according to this invention is inserted in e holder 40 end connected to a high-frequency generator 41 of 60 W end 1 MHz through e switch 43. On the other hend, the inlet port 6 for the coolant is joined to e coolent tank 42 vie a pump 44 through e pipe 48. Besides, the outlet port 7 Is connected to the pipe 48 so es to circulate the coolent used for cooling through the coolant tank 42.

Ice is charged together with cooling water in the coolant tank 42, and the pump 44 is actuated to circulate the cooling water. When e distributed electrode 46 connected to the high-frequency generator 41 through e lead wire 45 is brought into contact with the human body on the opposite side to the affected part, end the switch 43 is turned on, e high-frequency current 49 radially flows through the human body 47. As a result, e surface of the skin coming into contact with the planar electrode 3, at which e current density is highest, and subcutaneous tissues thereabout are heated.

However, the planar electrode 3 of this invention is cooled from its beck side by the cooling chamber 4. Therefore, as illustrated in FIG. 11, the surface 50 of the skin coming into contact with the planar electrode 3 end the tissue just under the surface 50 ere neither heeted nor coegulated, but only a subcutaneous tissue 51 at a distance of 2 mm or longer from the surface of the skin is heated, whereby e coegulated region 52 is formed.

With respect to this coegulated region 52, when the electrode assembly described in Example 1 is used, a coegulated region in a crescent form In section Is formed, as shown in FIG. 11, because of the insufficient coolIng capacity of the cooling chamber at its peripheral part. That may often bring about a result that an annular burn scar leaves.

When the electrode essembly described In Example 2 is used, the outer peripheral edge of the planar electrode 3 Is thoroughly cooled as shown In FIG. 12 because the working face 10 of the planar electrode 3 is defined inside the outer periphery of the bottom surfece of the cooling chamber 4. Therefore, the region positioned at the even depth from the surface of the skin is heeted, thereby forming e coegulated region 52' in e rectangular form in section.

An experiment on en enimel flesh was practicelly cerried out using en electrode essembly having the seme structure es that of Example 2. The following result was obtained.

Using a planar electrode In e circular form, which has a working face of 14 mm in diameter a, a high-frequency current of 1 MHz and 60 W was caused to flow for 3 seconds.

A coagulated region 52' of 14 mm in diameter and 6 mm In depth b was formed at e distance c of 2 mm from the surface of the skin. As shown In FIG. 12, this coegulated region 52' was quite flat reletive to the surface of the skin. No ebnormality was recognized on the surfece of the skin.

When a high-frequency current is caused to flow through the effected part from above the skin of the humen body using e high-frequency heeting end coegulating epparatus equipped with the electrode assembly according to the present invention, it is possible to selectively heat end coegulate the subcutaneous tissue at an even distance from the surface of the skin without being accompanied by any thermal injury or damage.

At that time, it is able to optionally control the depth, form end size of the coegulated region by changing the form end size of the working face of the planar electrode, end the intensity and epplication time of the high-frequency current.

Accordingly, the high-frequency heating end coagulating epparatus equipped with the electrode assembly can be used in remedy of the affected part

of the human body, for example, superficial vascular diseases, i.e., hemangioma, lymphangioma, varix and tumors in a shallow site under the skin.

In addition, it can also be used in selectively atrophying the subcutaneous fat in order to remedy impairment in beauty due to uneven distribution of the subcutaneous fat, or loosened skins due to corpulence and/or ageing.

Claims

1. An electrode assembly for a high-frequency heating and coagulating apparatus, comprising a planar electrode having a terminal, which is connected to a high-frequancy power supply, and a working face in the form of a flat or convex surface, and a hollow cooling chambar for cooling the working face from the back sida thereof, said planar electrode and hollow cooling chamber being formed integrally with each othar.

2. An alactroda assembly as claimed in claim 1 for the high-frequency haating and coagulating apparatus, wherein tha form of the planar alactrode is circular, samicircular, crascent, oval or polygonal.

3. An alectroda assambly as claimed in one of claims 1 and 2 for tha high-fraquancy heating and coagulating apparatus, wherein the cooling chamber is formed in such a manner that an annular cooling surface, which has been provided so as to surround the periphary of the working face of the planar alectroda, is cooled from the back sida thereof at tha same tima as the cooling of tha working face of tha planar alectroda.

4. An electrode assembly as claimad in ona of claims 1 through 3 for the high-frequency heating and coagulating apparatus, wharein the planar electrode and hollow cooling chamber are mada up integrally of an alectrically conductive material and a peripheral portion of the planar electrode is coated annularly with an electrical insulating material having good thermal conductivity so that the coated portion and the region inside tha coated portion function as an annular cooling surface and a working face of tha planar electroda, respectively.

5. An electrode assembly as claimed in one of claims 1 through 4 for the high-frequency heating and coagulating apparatus, wherein the planar electrode and hollow cooling chambar ara formed integrally by a curvad tuba mada of an electrically conductive matarial, an oval working face is formad in a convex surface of the tube, and the remaining portion of the tube is applied with a coating film of an electrical insulating material having good thermal conductivity to serva as a cooling surface.

6. An electrode assembly as claimed in one of claims 1 through 3 for the high-frequency heating and coagulating apparatus, wherein tha hollow cooling chamber is made up of an alectrical insulating material having good thermal conductivity so as to have a bottom surface greater than a planar electrode, and tha planar electrode is fitted in the bottom surface of the hollow cooling chamber at the substantial centre thereof, whereby a portion of the bottom surface, which is outside the periphery of the alectrode, is taken as an annular cooling surface.

7. An electroda assembly as claimed in one of claims 1 through 6 for the high-frequency heating and coagulating apparatus, wherein tha hollow cooling chamber is providad with an inlat port and an outlet port for a coolant.

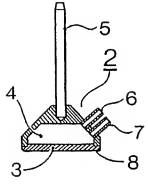

Fig.1

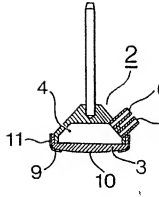

Fig.2

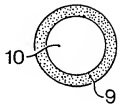

Fig.3

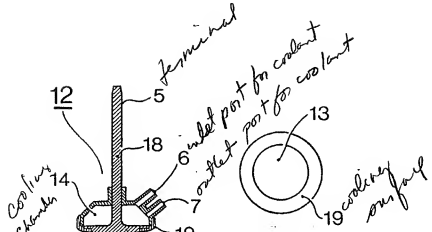

Fig.4

Fig.5

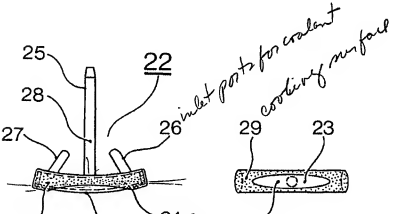

Fig.6

Fig.7

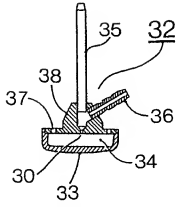

Fig.8

Fig.9

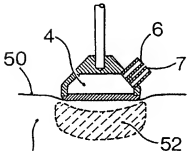

Fig.11

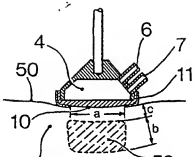

Fig.12

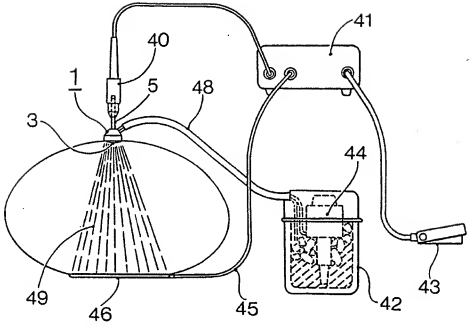

Fig.10

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(54) **Electrode assembly for high-frequency heating and coagulating apparatus.**

(57) An electrode assembly suitable for use in an apparatus for heating and coagulating a living tissue by a high-frequency current, comprises a planar electrode (3) having a terminal (5), which is connected to a high-frequency power supply, and a working face (3) in the form of a flat or convex surface, and a hollow cooling chamber (4) for cooling the working face from the back side thereof, said planar electrode and hollow cooling chamber being formed integrally with each other.

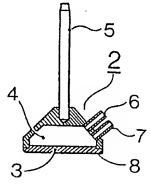

Fig.1

EP 0 480 639 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 30 9110

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-4 140 130 (STORM) * column 5, line 23 - column 8, line 25 * * column 9, line 59 - column 11, line 2; figures 1,3-6 *	1-3,7	A61N1/05 A61B17/39
A	---	4,6	
A	EP-A-0 251 746 (SOGAWA, KITAGAWA, ONODERA, ONUMA) * column 2, line 60 - column 3, line 37; figures 3A,3B *	1,2,7	
A	---	1-3,7	
A	US-A-4 290 435 (WAGGOTT) ---	1,3	
	DE-C-384 247 (MULLER) ---		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			A61N A61B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 JULY 1992	HERBELET J.C.

CATEGORY OF CITED DOCUMENTS

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